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Hazardous Waste Reduction Guidelines for
Environmental Health Programs

Ventura County Environmental Health Dept., CA

Prepared for:

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HAZARDOUS WASTE REDUCTION GUIDELINES

For
Environmental
Health Programs

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prepared for
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HAZARDOUS WASTE REDUCTION
GUIDELINES FOR
ENVIRONMENTAL HEALTH PROGRAMS

May 1987

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Project Authors: Deborah Hanlon ✓ *Jacobs ?*
Dana Determan
Ventura County Environmental
Health Dept.
Donald Koepp, Director

805-654-2813

Special Thanks to:

Jim Potter, Department of Health Services
Dr. David Leu, Department of Health Services
Jeff Health, Ventura County Environmental Health
Kieran Bergin, Los Angeles Sanitation District
Mary Ann Scott, Santa Barbara Resource Management
Dept.
Judy Ortung, San Bernardino County Environmental
Health
John Hill, Orange County Environmental Health
Linda Pratt, San Diego County Environmental
Health
Karen Peters, Orange County Fire Dept.
Susan Sherry, Local Government Commission
✓ Kim Wilhelm, Department of Health Services

FORWARD

Federal, state and local governments, working with industry, are preventing hazardous waste problems by reducing hazardous waste generation through innovative engineering and effective management.

Local governments throughout the State of California have developed comprehensive hazardous waste programs. These programs rely on "the community approach to the solution of environmental health problems."¹ This approach relies on voluntary compliance with environmental regulations and a government program of inspections, education, and a cooperative relation with the regulated community. Today, many environmental health departments and other local agencies provide businesses with on-site technical assistance towards compliance with hazardous materials and waste regulations. Through these programs, the jurisdictions have obtained the necessary expertise and relationships with industry to promote hazardous waste minimization at the local level.

These guidelines are part of a two year program in Ventura County that resulted in a 70% reduction of the volume of hazardous waste going to land disposal. This program demonstrates that local government can directly promote waste reduction without hindering established hazardous waste program efforts. The guidelines offers a variety of waste minimization components that can be developed in conjunction with new and expanded hazardous materials programs.

These Guidelines were developed to assist local governments achieve hazardous waste minimization objectives by utilizing the resources of existing hazardous waste programs. Although developed in a county environmental health program the model described herein can be used by any local hazardous waste program. The guideline's underlying premise is that waste reduction should be an integral component of every County and City hazardous materials management plan and that local government must become actively involved with industry to ensure that waste reduction methods are implemented.

¹See Ehlers and Steel, Municipal and Rural Sanitation, 1965, p.v.

HAZARDOUS WASTE REDUCTION GUIDELINES FOR ENVIRONMENTAL HEALTH PROGRAMS

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DEFINITIONS

The following definitions being used in this report have been adopted by the State Department of Health Services and the Environmental Protection Agency.

Waste reduction or minimization* includes any activity that reduces the volume or toxicity of waste from a given production process. Activities in order of preference include:

1. Source Reduction: Any activity that reduces or eliminates the generation of hazardous waste within a process. Source reduction is generally taken to mean not producing the waste in the first place. Hazardous waste "prevention" is preferred over waste "management" in which there will always be some environmental risk and regulation required. The potential for source reduction can be identified by examining how and why each waste is produced. This question can be best answered by individual generators, since waste generation and reduction is site and process specific.

Examples of Source Reduction Methods

Chemical Substitution
Spill prevention
Housekeeping
Inventory Control
Segregation

2. Recycling/Reuse: A waste is recycled if it is used, reused or reclaimed through reprocessing or regeneration. Solvents, oil, and empty containers are most amenable to both on and off-site recycling methods. The Department of Health Services maintains a List of Industrial Recyclers that accept waste from small and large quantity generators. The Department also maintains the Waste Exchange Program that facilitates the reuse of hazardous wastes.

*The terms waste minimization and waste reduction have similar meanings and are used interchangeably.

3. Treatment - Partial or total elimination of hazardous characteristics or volumes of a waste stream. After examination of source reduction and recycling potential, hazardous waste treatment may be required. Economic factors will determine if the treatment is to occur on or off-site.

Examples of Treatment Methods

Neutralization
Precipitation
Evaporation
Incineration
Filtration
Ion Exchange

4. Waste Reduction Consultation: An activity conducted by local government staff to provide generators with information on waste minimization opportunities.

Waste reduction consultations are co-operative efforts between inspector and plant personnel to identify waste reduction opportunities at each site resulting in the development and implementation of Hazardous Waste Volume Reduction Programs at each company.

5. Volume Reduction Program: A program developed by the generator that identifies waste minimization activities and goals. The program includes a series of steps including data gathering and analysis, identification of deficiencies, recommendations and an implementation schedule. It is an ongoing and continuous process that is supported by corporate management and involves all employees.

6. Waste Minimization Audit: A survey conducted by in-plant personnel or consultants which identifies and evaluates opportunities to reduce hazardous waste generation.

I. INTRODUCTION

Local governments must share in the responsibility for finding safe and effective solutions to the management and reduction of hazardous wastes that are generated within their jurisdictions. Today's established regulatory programs provide indirect economic incentives for waste reduction and even require generators to certify on the manifest that they have waste reduction programs in place. However, the legislative requirements are only meant to encourage voluntary actions and leave the choice for waste reduction processes, the degree of compliance and the definition of "economically practical" solely to the waste generator.

Local programs, through established relationships with hazardous waste generators and involvement in land use processes, can provide incentives, information and other assistance that is necessary to achieve significant hazardous waste reduction in their communities.

The model that is described in this report incorporates "Hazardous Waste Reduction" activities within Hazardous Waste Generator Regulatory Surveillance Programs. The model is based on a six step process which includes:

1. Obtaining and analyzing data;
2. Identifying Waste Reduction Potential;
3. Training hazardous waste inspectors to provide waste reduction consultations during generator inspections;
4. Obtaining industry commitment;
5. Obtaining intergovernmental support; and
6. Providing technical assistance to industry.

These Guidelines describe the role for environmental health departments and other local agencies to implement hazardous waste reduction programs. The technical assistance program provides regulatory and waste reduction information to generators as part of their overall hazardous waste program.

The first section of this manual explains the laws and regulations that encourage recycling and waste reduction.

The second section identifies waste reduction program development procedures; goals, objectives and activities. It also discusses training requirements, staffing and budgetary considerations and waste reduction consultation procedures.

Sections three through five provide information on industry recognition, ordinances and seminars. The Attachments provide examples of materials used in the development and implementation of local waste reduction programs.

Waste reduction issues are complex and rapidly changing. The aspects addressed in these guidelines by no means exhaust the subject. The intent is that they will, hopefully, provide direction and encouragement for local environmental health departments to implement hazardous waste reduction technical assistance programs to companies in their communities.

A. Background

Industries in California shipped over 1 million tons of hazardous waste to off-site treatment storage or disposal facilities during 1986. The cost of controlling that waste totals many millions of dollars annually, placing monetary burdens on California's economy. While a portion of this waste is recycled, the majority of it is placed into the land or incinerated where it can disperse and migrate into the environment.

As the costs of administering environmental programs and costs of compliance mount, the benefits of reducing chemical use and waste generation at its source have become more compelling.

Waste reduction is one most economical and environmentally sound response to the hazardous waste issue today. Furthermore, waste reduction is critical to the prevention of future hazardous waste problems and can benefit industry by lowering liability, risks and costs for regulatory compliance.

B. Authority - Legislative Requirements for Waste Minimization

The Hazardous and Solid Waste Management Act of 1984 amended the Resource Conservation and Recovery Act (RCRA) and included specific Congressional mandates for waste minimization. The statutory sections applicable to generators of hazardous waste are:

RCRA Section 3002(b): Effective September 1, 1985 each hazardous waste manifest shall contain a certification that the generator (1) has a program in place to reduce the volume or toxicity of such waste to the degree determined by the generator to be economically practical and (2) that the proposed method of treatment, storage, or disposal is that practicable method currently available to the generator which minimizes the present and future threat to human health and the environment.

The 1984 RCRA amendments also require generators of hazardous waste to submit a biennial report to E.P.A. which must include a description of their efforts to reduce the volumes and/or toxicity of wastes generated.

In addition to the Federal requirements, California's hazardous waste regulatory program provides a driving force for moving industry towards waste minimization and alternative technologies. The State's land disposal phase out program, recycling regulations and waste reduction efforts promote safe handling of hazardous wastes including source reduction, recycling and treatment. Tables Ia and Ib describe specific wastes that are targeted for these programs.

C. Land Disposal Restrictions

Title 22 of the California Administrative Code beginning with Article 12, Section 66763 discourages the disposal of recyclable wastes in California. Table I-a lists wastes that are considered to be recyclable and subject to the state's regulations.

Table I-a
List of Recyclable Wastes

<u>California Waste Code</u>	<u>Type</u>
211	Halogenated Solvents
212	Oxygenated Solvents
213	Hydrocarbon Solvents
214	Unspecified Solvents
221	Waste Oils
512	Empty Containers
111	Unspent Acids
123	Unspent Alkalies

California's land disposal restrictions prohibit land disposal of liquid wastes that contain any of the following materials above the indicated level in Table I-b.

Table I-b
Land Disposal Phase Out Schedule

<u>Effective Date</u>	<u>Waste Type</u>
January 1, 1985	1. Free Cyanides (1,000 ppm)
	2. Toxic Metal Waste: Arsenic (500 ppm) Chromium VI (500 ppm) Mercury (20 ppm) Selenium (100 ppm) Cadmium (100 ppm) Lead (500 ppm) Nickel (134 ppm) Thallium (130 ppm)
	3. PCB's (50 ppm)

Table 1-B (continued)

	4. Acids (< pH 2.0)
	5. Liquid halogenated organics(1,000 ppm)
January 1, 1985	1. Bulk Liquids
January 1, 1988	Prohibits disposal of hazardous wastes having a heating value of more than 3,000 BTU's per pound (Health and Safety Code 25155.5).
June 30, 1988	Prohibits discharge of any liquid hazardous wastes into surface impoundment (Health and Safety Code 25208.4).
May 8, 1990	Hazardous Waste Management Act of 1986 - Prohibits disposal of liquid hazardous wastes in landfills and prohibits the land disposal of all untreated hazardous wastes (H & S Code Chp. 6.5, Section 25179.1).
June 1, 1990	1. Prohibits disposal of liquid and untreated hazardous wastes in landfills (Health and Safety Code, Section 25200.2(b)(c)).

In addition EPA is expanding its land disposal restrictions program. Solvents and liquids are now banned under the federal program.

D. Tanner Requirements for Waste Reduction

AB 2948, 1986 (Tanner) establishes local programs and procedures to facilitate the siting and permitting of hazardous waste facilities (Health and Safety Code Sec. 25135 et seq.). The bill allows counties and/or cities to prepare hazardous waste management plans. The plans will include:

- a. Analysis of waste stream.
- b. Descriptions of existing hazardous waste TSD facilities.
- c. Analysis of the potential for recycling and reducing hazardous waste.
- d. Household hazardous waste management programs.
- e. Determination of the need to site.
- f. Description of existing programs.
- g. Developing local policies to address hazardous waste issues.

The potential for hazardous waste reduction is meant to be fully explored prior to the determination that a storage, treatment or disposal site is necessary. In addition, the Tanner Process will require waste reduction in lieu of siting a facility when possible.

II. LOCAL WASTE REDUCTION PROGRAM DEVELOPMENT

A. Planning

In order to incorporate a hazardous waste reduction element into local programs, it is necessary to identify needs and resources available in the local jurisdiction before plan development.

There are a variety of possible approaches to local hazardous waste reduction programs. Local agencies may, for example, choose to:

- o Provide information to all generators;
- o Conduct inspections and waste reduction consultations to all generators or target specific industry and/or waste streams;
- o Require generators to submit Volume Reduction Plans;
- o Conduct seminars and workshops, etc.

The program will, of course, be dependent on each jurisdictions needs, resources and capabilities. To determine local needs, it is necessary to first obtain and analyze hazardous waste data pertinent to its jurisdiction.

In order to assist in the preplanning process, the following steps have been identified.

1. Data Collection and Analysis

Each jurisdiction should collect data on local generators of hazardous waste, identify types, quantities, disposition and why each waste is produced. The key to waste reduction is knowing waste composition and the reasons wastes are produced. A thorough waste characterization study that includes data collection and analysis will provide direction for program development and implementation by identifying problem areas.

Hazardous waste reduction programs can focus on a variety of problem areas. For example, a program's effort may target all liquid

wastes being shipped off site for disposal or on certain waste streams or industry type. Appendix 1 is an example of a study which identified specific problems that became the focus of a Waste Reduction Program.

2. Waste Reduction Potential

Determining the potential for waste reduction through source reduction, recycling and treatment is an important step in the development of a local program. This step will be the result of data analysis and gathering information on technologies, incentives and barriers to waste reduction. Specified wastes will be identified for reduction through this process.

3. Training

Hazardous waste generator inspection personnel must be trained to perform waste reduction consultations during routine generator inspections or at least provide information on waste reduction. Inspectors must also be given the necessary resources in order to provide technical assistance to the generator. Informational resources, inspection checklists and recommended training outlines are provided in this manual.

4. Industry Support

Corporate commitment is necessary to accomplish waste reduction objectives. Plant engineers and managers may identify waste reduction techniques, but unless they are given support and resources from the corporation, little is likely to occur. Environmental Health programs can gain corporate commitment by having generators sign "agreements" that they will participate in the waste minimization effort.

5. Local Government Support

Local government can adopt official policies to promote waste reduction. The premise behind this approach is to formalize policies within the community that will provide industries with a clear direction to

reduce wastes. A general policy statement promoting waste reduction should be made at the County, city and special district levels in order to ensure that toxics removed from one area of the environment (water) are not shifted to another area (land). Interagency coordination and cooperation is essential to the development of a multidisciplinary approach to hazardous materials/waste management.

Planning and building officials will also be involved in the siting of new industry and treatment facilities. A useful tool to ensure adequate hazardous waste management capacity exists within a region may be to require new generators to submit a waste reduction and management plan prior to locating in an area.

The following section identifies possible goals, objectives and activities for waste reduction programs. Specific objectives and components can be developed according to local needs and resources.

B. Goals

The overall goals of local waste reduction programs are to:

1. Provide technical assistance to industry;
2. Ensure that hazardous wastes are not produced unnecessarily; and
3. Ensure land disposal is used only for those wastes that do not pose a threat to public health and the environment, now or in the future.

C. Objectives and Activities

Phase 1 - Needs Assessment

OBJECTIVE 1: To characterize hazardous waste generation patterns and identify those industries that produce the wastes.

Activities:

- a. Identify types, quantities and disposition of wastes produced within the County. This information can be obtained from inspections, DOHS Information, Industrial Waste Discharge Programs, and Fire Departments (Appendix 2 provides CLIST information).
- b. Identify chemical profile of wastes generated in order to identify treatment reduction potential. This information can usually be obtained from generator's manifest files and from lab reports.
- c. Identify and categorize companies that generate hazardous waste in order to prioritize efforts.
- d. Analyze data in order to identify problem and prioritize program efforts.

OBJECTIVE 2: To determine the type and volumes of wastes that are amenable to source reduction, recycling and treatment.

Activities:

- a. Obtain information on source reduction, recycling and treatment technologies. Include the California Waste Exchange List of Industrial Recyclers, financial opportunities, names of reputable waste reduction engineers and various equipment vendors to assist in effort.
- b. Compare wastes generated as identified in Objective 1 with available source reduction, recycling and treatment options.

OBJECTIVE 3 To develop program needs and obtain resources to implement plan.

Activities:

- a. Set goals, objectives and activities based on the analysis in Objective 1.
- b. Assess local opportunities and resources for implementation. Target industry groups, waste streams, etc., for reduction.
- c. Identify regulatory limits to waste reduction.
- d. Provide for interagency coordination to develop a viable multi-disciplinary strategy for hazardous waste reduction and management.
- e. Identify methods to implement plan and measure outcome.
- f. Develop staffing and budgetary needs.

Phase 2 - Implementation

OBJECTIVE 4 To disseminate information to industry and staff that will promote source reduction, recycling and treatment of wastes.

Activities:

- a. Inform industry of local waste reduction effort through newsletters, media contact and direct mailing.

- b. Develop informational and educational materials in order to provide industry with information on source reduction, recycling and treatment opportunities.
- c. Distribute information to industry and citizen groups for program enhancement, (i.e. Chamber of Commerce, etc.).
- d. Present seminars and speeches in order to communicate with local industry.
- e. Train hazardous waste personnel to provide waste reduction consultation and/or distribute information to companies during routine inspections.

OBJECTIVE 5 To encourage industries to reduce generation of hazardous wastes.

Activities:

- a. Ask companies in target group to voluntarily participate in Local Waste Reduction Program.
- b. Provide waste reduction consultations during routine generator inspections.
- c. Require each targeted generator to submit a written plan to implementing agency.
- d. Assist companies overcome financial/regulatory barriers to waste reduction.
- e. Develop an awards program to recognize industry achieving waste reduction (or participating in program).
- f. Propose needed legislation and local ordinances to promote, not impede, waste reduction efforts.
- g. Develop interagency relations that will ensure new companies utilize the best available technologies to reduce the amount of hazardous wastes generated and prevent waste media transfer.
- h. Establish information exchange programs to share successful waste reduction technologies to other companies and staff inspectors.

- i. Ensure that waste management capacity exists for new generators coming into jurisdiction.

Phase 3 - Evaluation

OBJECTIVE 6

To evaluate and redirect programs for maximum efficiency.

Activities:

- a. Track annual hazardous waste generation and disposal activities by obtaining current data from Manifest Information System and local inspections.
- b. Utilize the local Hazardous Waste Management Plan to set long-term goals.
- c. Survey industry to identify continuing problems, needs and resources.

D. Waste Reduction Consultation Procedures

Local programs that provide businesses with direct on-site technical assistance in compliance with hazardous materials/waste regulations can expand the assistance to provide waste reduction consultations.

A waste reduction consultation is a service provided by local program staff with plant representatives which identifies and evaluates opportunities to minimize hazardous wastes.

A waste reduction consultation can be provided during routine inspections. The consultation can provide the generator with insights as to where waste minimization efforts should/could be focused. A report left with the generator that provides the company with compliance requirements can also outline recommendations for waste reduction. This will assist in obtaining management support for changes as well as directing waste reduction planning at that facility.

A waste reduction consultation should include evaluations of a generator's practices in the following areas:

1. Facility Description - Staff will identify products and processes used, types of hazardous materials at the facility, wastes generated and disposal/recycling methods, and list regulated activities, i.e., air, sewer, underground tanks, etc. The age of the facility and plans for upgrading should be noted here also.
2. Raw Materials Handling - Staff will identify raw chemical storage and handling methods and possibly identify associated source reduction measures that can be implemented in this area. Source reduction measures include segregation, procurement changes, utilizing refillable or recyclable containers and using pipelines for intermediate transfer.
3. Process Operation - Staff will examine all areas of the manufacturing process to identify sources of waste generation and possible waste minimization measures. Examples of waste minimization methods during manufacturing processes include optimizing reaction variables and methods, using wet instead of dry grinding, avoid cross-contamination of chemicals, substituting chemicals for less hazardous ones, (trivalent chrome in place of hexavalent chrome, eliminate cyanides and use of hydrofluoric acid).

In addition, the majority of hazardous wastes are produced during rinsing and cleaning phases. There are numerous source reduction methods that can be implemented to accomplish this more efficiently. Methods include using multiple rinse tanks, installing drain boards, using fog nozzles, recycling rinse waters and using mechanical versus chemical cleaning procedures.

During this phase of the inspection, staff can focus on facility maintenance and operation to truly identify how and why each waste stream is produced. It has been shown that companies have been able to reduce hazardous waste generation up to 98% by eliminating bad batches and leaks and spills through diligent maintenance and employee awareness programs.

4. Hazardous Waste Reduction Planning - The outcome of the waste consultation is to provide the generator with information to develop and implement a Volume Reduction Plan. The plan will identify long term goals and future waste management needs. The inspector will also be able to identify from the consultation, specific areas of concern to the generator. In many instances Environmental Health staff will be able to facilitate opportunities for the generator to resolve hazardous waste problems.

An example checklist that may be used during routine inspections and waste reduction consultations is provided in Attachment 1. Waste Reduction Plan Guidelines and methodology tables are provided in Attachments 2 and 3.

E. Hazardous Waste Reduction Personnel Training

A successful waste reduction program requires that inspectors are trained to provide waste reduction consultations. The extent and nature of the training will vary depending upon the backgrounds of the individuals. Additionally, the frequency of recurring training will vary depending upon the organization, availability of courses and new technologies and industry trends.

Understandably, inspectors must be trained technically to be able to deal with very complex compliance management requirements. Perhaps more importantly, they must also develop skills in conducting probing interviews with personnel having a wide variety of educational and employment backgrounds. Inspectors must walk a fine line between being supportive to plant supervisors' management of environmental affairs and being assertive in their probing for areas of noncompliance. It is a task requiring both diplomacy and firmness since the final outcome of the inspection/consultation should be voluntary compliance and waste reduction.

Specially organized in-house training can be extremely beneficial. In addition, consultants can bring a large number of different experiences to a training exercise and can provide the expertise or program start-up, which may be otherwise unavailable to the organization.

Today there are many training and educational opportunities for hazardous waste reduction. A training program would include reading lists, conferences and seminars, and courses through University Extensions. Subscriptions to magazines and association conference proceedings can also provide very current information.

With the organization, tools, and trained personnel in place, a recommended step would be to conduct one or more practice consultations at plant sites. In this light, the program manager may want to test the inspectors' abilities to conduct an investigation commensurate with the potential problems associated with the range of company sites. Therefore, she/he may want to select one large, complex facility and one small, fairly risk-free facility to inspect. The intensity and duration of the investigations for

these facilities should vary considerably and, therefore, testing the inspection and consultation method at each site would be a useful exercise.

Attachment 4 suggests topics and concepts that could be included in staff training programs to enhance local waste reduction efforts.

F. Staffing and Budgetary Considerations for Waste Reduction Activities

The following Staffing and Budgetary needs are based on the activities identified in Ventura County's pilot program. The workload assumes that one, full time project coordinator is appointed. The coordinator should have a strong hazardous waste management background with knowledge of local and State resources. The County program works with the State Department of Health Services, Alternative Technology Section in a cooperative manner to fulfill the goals and objectives of the State's Waste Minimization Program at the local level. The degree of participation will of course be dependent on its own jurisdiction's needs, resources, capabilities and policies. For example, not all jurisdictions will choose to issue TSD Variances or conduct waste reduction consultations.

This model describes activities for a Hazardous Waste Reduction Element within an existing program and allows for flexible waste reduction activities. The "model" utilizes one full-time program coordinator and existing personnel to conduct waste reduction consultations during routine inspections. Program activities can be added to existing hazardous waste management plans.

Experience has shown that incorporating a waste reduction consultation with routine regulatory inspections may increase inspection time between 5 and 25 percent depending on size and condition of company.

The majority of time is spent by the project coordinator in developing programs, obtaining resources and training staff members to conduct waste minimization consultations.

STAFFING AND BUDGETING WORKSHEET FOR WASTE REDUCTION PROGRAMS (EXAMPLE VENTURA COUNTY PROGRAM)

Activity	Estimated Hours Per Activity	Annual Staff Days Required	Budget Estimate	Program Revenue
Program Manager Training		20	\$1,000.00	
Data Collection and analysis		15		
Program Plan Development		10		
Interagency Coordination		10		
Information/Seminar Development		25		
Staff Training		20 per person		
Conduct Waste Reduction Consultations	8	100		Generator Fees
Plan Checks for new Businesses	4	5		Plan Check Fees
TSDF Variance Inspections	16	8		Generator Fees
TOTAL*				

* Total = $\frac{\text{Number of Staff Days}}{230 \text{ Staff Days per Year}}$ = Staff Years Required for Program

STAFFING AND BUDGETING WORKSHEET FOR WASTE REDUCTION PROGRAMS

Activity	Estimated Hours Per Activity	Annual Staff Days Required	Budget Estimate	Program Revenue
Program Manager Training		20	\$1,000.00	
Data Collection and Analysis		10-20		
Program Plan Development		10		
Interagency Coordination		10		
Information/Seminar Development		25		
Staff Training		20 per person		
Conduct Waste Reduction Consultations	8			Fee Schedule
Plan Checks for New Businesses	4			Plan Check Fees
TSD Variance Inspections	16			Generator/Variance Fees
TOTAL*				

* Total - Number of Staff Days
= Staff Years Required for Program

III. LOCAL ORDINANCES AND RESOLUTIONS TO PROMOTE WASTE REDUCTION

Local agencies considering a waste reduction program may be confronted with a lack of clear and enforceable directives. In addition, they must find a method of funding their programs. This section describes a local ordinance which would address those problems.

The cost of this model comprehensive hazardous waste program is offset by a "fee for service" system. Hazardous waste producers are required to obtain a Permit to Operate and to pay an annual fee. As a condition of their permit, producers are required to develop and implement waste reduction programs.

New businesses are required to obtain a permit to construct from the local agency, and to submit building and process plans for review. The plans are required to include information describing methods to be used to minimize the production of hazardous wastes. This will help to ensure that all new businesses within the local agency's jurisdiction utilize available waste reduction opportunities and that there will be sufficient TSDF capacity to handle their waste load. A model ordinance that provides for a comprehensive hazardous waste generator program that emphasizes waste reduction is provided in Attachment 5.

In addition, a "Model Resolution" can be adopted in each jurisdiction in order to promote the general concept of waste reduction, Attachment 6.

IV. RECOGNITION GUIDELINES

A. Introduction

Maximum results in waste reduction are more likely to occur if industry is involved at all levels, from management to workers. Recognition of waste reduction efforts, particularly at Board level, encourages this involvement. Public recognition also helps to inform the public of actions taken by government and industry to reduce and control hazardous wastes. The following are suggested guidelines for a program of public recognition and employee involvement.

1. Ask for voluntary participation in Waste Minimization Program (Attachment 7).
2. Recognize each participant (Attachment 8).
3. Award significant achievers in Public Forums.

Recognition programs can be varied to accommodate each company, their level of involvement, and local attitudes. For instance, public recognition such as an award or certificate may be welcomed by many companies. Other companies, however, maintain a "low profile" as a matter of policy. In such cases, a letter from the Board may be preferred. The effectiveness of this program could be increased by combining it with other awards, such as an employee-of-the-month program, or a percentage of the cash savings realized by a suggestion.

All companies that voluntarily participate in the Waste Minimization Program are recognized. The "Model" Participant Letter also serves to encourage corporate commitment to waste reduction.

V. BUSINESS OUTREACH PROGRAMS

A. Workshops/Seminars

Information dissemination is critical to successful implementation of source reduction programs. Industries need to be made aware of not only the laws and regulations governing hazardous wastes, but also policies, local considerations and technologies that may affect their decision making process.

Local workshops and seminars provide industry with the necessary information to go forth with effective Volume Reduction Programs. The workshops can provide a forum for industry and government to share ideas and mutual concerns regarding hazardous wastes. Attachment 9 includes suggestions for agendas for Hazardous Waste Reduction seminars. The example seminars provide sponsors with ideas for topics that may be discussed. Agendas should be developed with a great deal of input by industry representatives to ensure maximum impact and participation.

Professional staff can also attend employee safety meetings at plant locations in order to involve all employees in waste reduction awareness. Outreach programs can target industry associations, executive conferences and community groups as well.

In addition, written handouts, vendors' lists, posters and guidelines can provide industry with information that is necessary to implement an effective waste reduction program.

ATTACHMENT 1

HAZARDOUS WASTE GENERATOR INSPECTION CHECKLIST

<u>GENERATOR REQUIREMENTS</u>	<u>CORRECTIVE ACTION NEEDED</u>	<u>ITEM IN COMPLIANCE</u>
HAZARDOUS WASTE DETERMINATION		
CAC T-22 (66471)		
Generator has determined if waste is hazardous or <u>extremely hazardous</u> :	_____	_____
EPA IDENTIFICATION NUMBER		
CAC T-22 (66472)		
Generator has EPA ID Number for manifesting wastes shipped off-site:	_____	_____
MANIFEST		
Generator shall complete producer-of-waste section of manifest & give to registered hazardous waste hauler when shipping waste off-site:	_____	_____
CAC T-22 (66484)		
Generator signs certification statement that he has a Volume Reduction Program in place:	_____	_____
CAC T-22 (66481)		
Applicable sections accurately completed for all waste transported off site, except for waste being transported by registered hauler who has obtained a manifest variance from State Department of Health Services (DHS):	_____	_____
CAC T-22 (66481)		
Copies of manifest available for review:	_____	_____
CAC T-22 (66492)		
Properly completed copies submitted to DHS:	_____	_____
CAC T-22 (66484)		

ATTACHMENT 1 (con't)
HAZARDOUS WASTE GENERATOR INSPECTION CHECKLIST

<u>GENERATOR REQUIREMENTS</u>	<u>CORRECTIVE ACTION NEEDED</u>	<u>ITEM IN COMPLIANCE</u>
DISPOSITION OF WASTE		
Hazardous waste taken only to State-permitted facility:	_____	_____
H&S (25191)		
Unnecessary generation of waste is avoided	_____	_____
RCRA (3002)		
Appropriate wastes are recycled:	_____	_____
CAC T-22 (66796)		
EXTREMELY HAZARDOUS WASTE		
CAC T-22 (66570)		
Extremely hazardous waste <u>not</u> handled nor disposed of without permit:	_____	_____
No deviation from DHS-approved handling/-disposal methods:	_____	_____
STORAGE/ACCUMULATION REQUIREMENTS		
All waste is moved off-site to an approved facility within 90 days of commencing accumulation:	_____	_____
CAC T-22 (66508)		
Containers are in good condition:	_____	_____
CAC T-22 (67241)		
Containers are stored in a manner that prevents spills & escape from designated area:	_____	_____
CAC T-22 (67245)		
Hazardous waste storage area is secure to prevent unauthorized people from having access:	_____	_____
Containers are labeled to identify type of waste & are marked with date of start of accumulation:	_____	_____
CAC T-22 (66508)		
Stored waste does not cause corrosion, leakage or premature failure of container:	_____	_____

ATTACHMENT 1 (con't)
HAZARDOUS WASTE GENERATOR INSPECTION CHECKLIST

<u>GENERATOR REQUIREMENTS</u>	<u>CORRECTIVE ACTION NEEDED</u>	<u>ITEM IN COMPLIANCE</u>
CAC T-22 (66241)		
Uncovered tanks have two-foot (2 ft.) or 60-cm freeboard, dikes or other containment structures:	_____	_____
CAC T-22 (67257)		
Incompatibles are stored/protected in separate tanks and drums, and stored in separate areas:	_____	_____
CAC T-22 (67247)		
Wastes are segregated to promote recycling:	_____	_____
PRE-TRANSPORT REQUIREMENTS		
CAC T-22 (66504)		
Waste is packaged, labeled & placarded according to 49 CFR (DOT):	_____	_____
Each container of 110 gallons or less is marked properly:	_____	_____
TRAINING		
CAC T-22 (67105)		
Employees receive training within 6 months after being hired:	_____	_____
Employee training records are maintained:	_____	_____
PREPAREDNESS FOR AND PREVENTION OF EMERGENCIES		
CAC T-22 (67121)		
Appropriate communication/alarm systems:	_____	_____
Appropriate firefighting, spill control, and decontamination equipment:	_____	_____
CONTINGENCY PLAN AND EMERGENCY PROCEDURES		
Arrangements made with local authorities/- emergency response teams:	_____	_____
CAC T-22 (67126)		

APPENDIX 1 (CON T)
HAZARDOUS WASTE GENERATOR INSPECTION CHECKLIST

<u>GENERATOR REQUIREMENTS</u>	<u>CORRECTIVE ACTION NEEDED</u>	<u>ITEM IN COMPLIANCE</u>
Generator has prepared contingency plan and its maintenance for the site:	_____	_____
CAC T-22 (67140)		
VOLUME REDUCTION PLAN		
RCRA (3002)		
Generator has a Volume Reduction Program in place:	_____	_____
Plan identifies waste minimization efforts and goals:	_____	_____
Generator has examined all source reduction potential:	_____	_____
Recyclable wastes are recycled on or off-site:	_____	_____
Spills and leaks are avoided in raw materials storage area, plant operations and waste storage:	_____	_____
Plant personnel are trained in waste minimization techniques:	_____	_____
Facility is operated and maintained to reduce the amount of hazardous wastes discharged to the air, water or land:	_____	_____
RECORDKEEPING AND REPORTING		
CAC T-22 (66492)		
Manifest, Annual Report, Exception Reports, and test results retained by generator for at least three (3) years:	_____	_____
Submittal of Bid Annual Report to DHS:	_____	_____
Submittal of Annual Report to Board of Equalization:	_____	_____
CAC T-22 (California Administrative Code Title 22, Section 66001 et seq.)		
H&S (Health and Safety Code Chapter 6.5, Section 25100 et seq.)		
RCRA (Resource Conservation and Recovery Act 1984)		

HAZARDOUS WASTE MINIMIZATION GUIDELINES

The Hazardous and Solid Waste Management Act of 1984 included specific Congressional mandates on waste minimization. The statute regulating generators of hazardous wastes requires the following:

Effective September 1, 1985, the manifest shall contain a certification by the generator that:

- a. The generator of the hazardous waste has a program in place to reduce the volume or quantity and toxicity of such waste;
- b. The proposed method of treatment, storage, or disposal is that practical method currently available to the generator which minimizes the present and future threat to human health and the environment.

The 1984 Amendment represents a relatively small step for government, but clearly invited numerous and broad steps for private business and industry. The success of management to deal with the many complex questions turns on a firm's ability to properly plan and manage its waste reduction program.

Unfocused, ill-timed or poorly managed waste reduction efforts will lead to low performance and high cost. Conversely, a successful program must be well conceived and effectively implemented. For this, a **Waste Reduction Plan** offers significant value.

WHAT IS A WASTE REDUCTION PLAN?

Waste Reduction Plans can be effective tools in reducing the volume of hazardous waste produced. A Waste Reduction Plan is a document describing the procedures, goals and timing by which a generator will reduce the volume, quantity or toxicity of hazardous waste. Waste reduction is defined as any activity or treatment undertaken by a generator that minimizes the generation of hazardous waste. Waste reduction is brought about by on-site procedures not only at the point of waste generation, but throughout the production operations including maintenance, repair and storage. Waste avoidance will eliminate the need to manage waste and will reduce associated risk and liability.

Waste reduction can be achieved through a wide array of processes that range from simple changes in "housekeeping" practices to the total replacement of production technology. The various types of waste reduction can be arrayed in a hierarchy of performance for reducing chemical risk. These include:

1. Chemical substitution (a hazardous chemical substituted by a less hazardous chemical).
2. Product substitution (producing less toxic products or products that are less hazardous to produce).
3. Chemical process changes (changes in production that result in less chemical use or safer chemicals used).
4. Improving production management (reducing spills, leaks, vaporization, etc., reducing mixture errors and bad production runs).
5. Reclaiming, recycling and reusing chemicals.
6. Point of generation treatment and detoxification.
7. Improving waste management (including improved storage and treatment).

Planning offers ways to improve management capacity and introduce new technologies and practices. Much of the planning necessary to reduce waste requires:

- Increased awareness and attention to toxic chemicals.
- Increased motivation to change existing patterns.
- Knowledge of potential options for change.
- Willingness to experiment and change.
- Resources to implement changes.
- Willingness to follow through, evaluate and learn from such changes.

These elements are advanced when corporations prepare Waste Reduction Plans. Once developed, the plan then becomes a guide for raising the level of attention to toxic and hazardous wastes. The plan can increase motivation to change, present alternatives, guide decision making and provide information to evaluate the consequences of change.

WASTE MINIMIZATION PRINCIPLES

Waste minimization principles for industrial application can be classified under the following five headings:

I. Information. No waste minimization program can succeed without precise information on the natures and magnitudes of the wastes involved. Material balances and careful waste audits are preconditions for waste minimization. Information on minimization potentials for wastes then must be comprehensively assimilated.

II. Management. Both employees and managers must be given comprehensive training on waste minimization, along with incentives to maintain and promote waste minimization practices.

Experience has shown that management effectiveness is a substantive part of waste minimization success. Employees can be motivated by rewarding suggestions and actions that lead to waste reduction.

III. Maintenance. Significant housekeeping gains in waste minimization are possible through rigorous maintenance of plant equipment. Maintenance may be the least glamorous but is one of the most important aspects of waste minimization.

Housekeeping can accomplish about half of the total waste minimization possible through efficiency increases and process change. The 50% for which process change is responsible is, to date, a generally untapped potential. While some basic process change has effected significant waste reduction, emphasis has been on the housekeeping side. Relatively simple process change steps such as eliminating wet plating baths have been demonstrated. Direct materials substitution is another dimension of process change which has some application.

The direct reuse and recycling of waste provides the last major option in waste reduction.

IV. Design. From improving efficiencies to changing basic processes, design is the key to maximizing waste minimization efforts. Rearranging processing sequences to allow recycling of rinse waters, changing from wet to dry printing, eliminating toxic steps, and substitution of less toxic materials for standard raw materials are all examples of design changes which lead to waste minimization.

V. Planning. As industries grow and as product lines change, planning is necessary to accommodate these phenomena. Planning for increased waste minimization should go hand in hand with any industrial planning effort. Remember, waste minimization should not be viewed as 'new technology' but should be incorporated into business practices just as productivity and goal setting mechanisms are.

ELEMENTS OF A VOLUME REDUCTION PLAN

I. Inventory: Raw products and waste sources.

- Material/waste balance
- Sources of chemical use and waste generation
- Points of waste discharge
- Chemical profile of waste (why is it hazardous)
- Disposition of wastes and disposal costs

II. Priority Framework

- Review chemical hazards
- Risk Assessment
- Identify criteria for importance
- Prioritize wastes for minimization

III. Alternative Process Description

- Identify Housekeeping/production changes for minimization
- Survey literature and equipment
- Cost estimation (include initial costs, amortization, depreciation, tax rebates, pay back potential)
- Selection of alternatives (prioritize and list conditions for adoption)

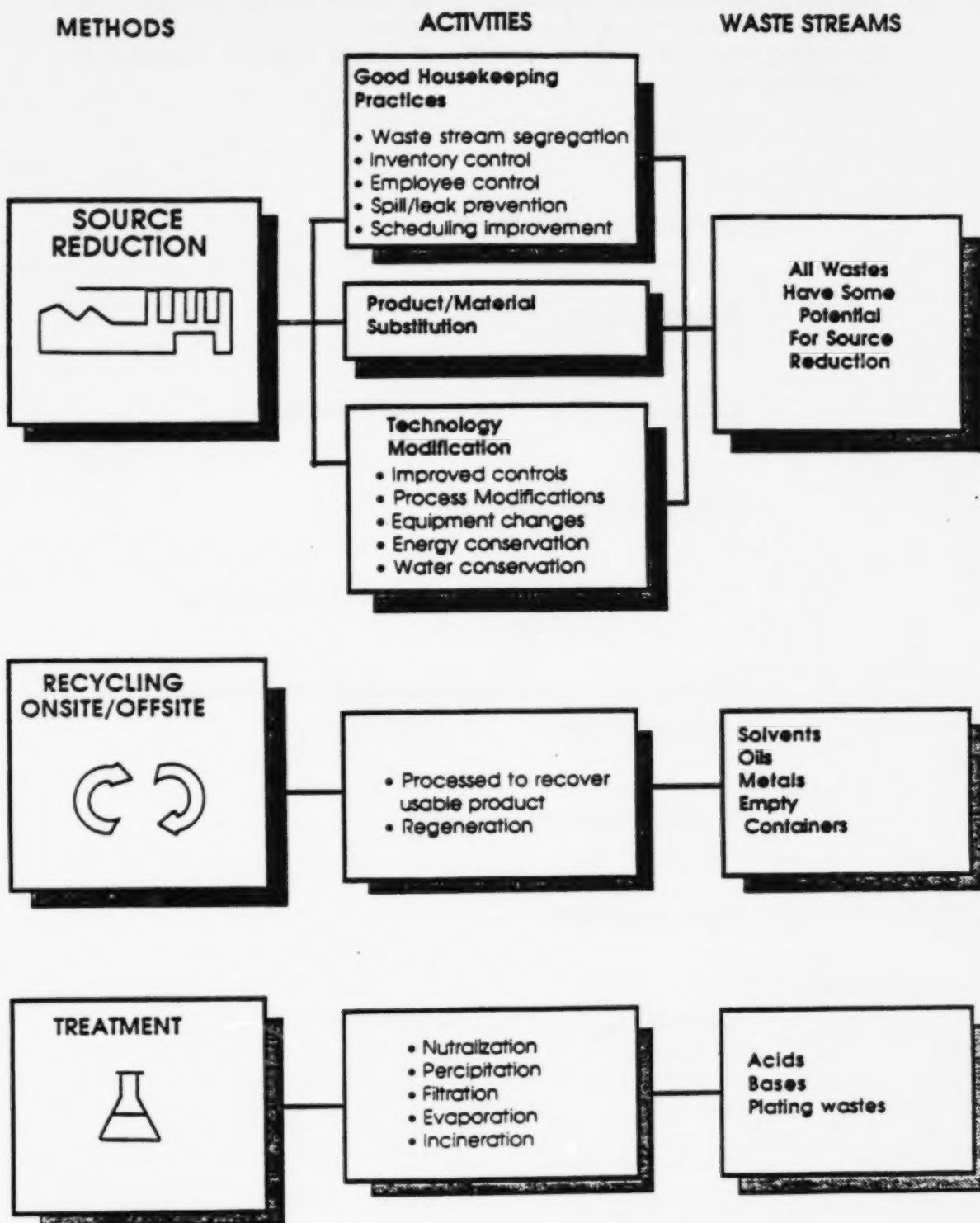
IV. Schedule and Targets

- Identify steps or phases for implementation
- Identify tasks and personnel assignments
- Set target dates for completion

V. Monitor and Evaluation

- Identify reporting procedures
- Establish evaluation protocol
- Establish outcome objectives and range of acceptability
- Educate and involve all facility personnel

WASTE MINIMIZATION TECHNIQUES



WASTE MINIMIZATION WILL SAVE YOU MONEY

Waste minimization projects differ from other projects with respect to the types of costs affected. Cost savings due to lowering volume and/or toxicity of waste can be found in the following areas:

- **Disposal fees**
- **Generator fees/taxes**
- **Transportation costs**
- **On-site waste storage and handling**
- **Predisposal treatment**
- **Permitting, reporting, and recordkeeping**
- **Emergency preparedness and site cleanup contingency**
- **Pollution liability insurance**
- **Raw materials**
- **Operating and maintenance costs**

ATTACHMENT 3 WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial* Recyclers	On-Site Treatment/Vendors**
Waste oil & mixed oil	221		DeMenno-Kerdoon Fluid Recycling Svcs. Triple J Edgington	Oil/water separators clarification systems oil & grease skimmers Vendors: Samsco Tenco Hydro
Pesticide rinse water	231	Use multiple rinse tanks, install drain boards & drip tanks, recycle & reuse rinse water		Destruction with chlorine or lime. Incineration, carbon adsorption Vendors: GA Technologies Canonie Environmental
Tank bottom waste	241	Determine if hazardous by testing	DeMenno-Kerdoon Systech McAuley Oil Co.	Dewatering, skimming, filtration

* See California Waste Exchange List of Industrial Recyclers

** See Ventura County Waste Reduction Resource Directory

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial * Recyclers	On-Site Treatment/Vendors **
Paint sludges	461	Use equipment with low overspray, inspect all parts before painting Use paints without metal pigments	Pacific Coast Lacquer	Pyroslis - Pollution Control Products Resolver - distillation Solidify by drying
Empty containers 30 gallons or more	512	Use rinsable, and/or recyclable containers, purchase materials in bulk, use pre-weighed packages	Rose Cooperage Waymire	Triple rinse containers
Empty containers 30 gallons or less	513	Use rinsable, and/or recyclable containers, purchase materials in bulk, use pre-weighed packages		Triple rinse containers

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial * Recyclers	On-Site Treatment/Vendors **
Drilling mud	521	Determine if hazardous by testing		Dewatering methods Vendors: WMI-West So Mat Bio-Nomic Filtronics Edward & Jones, Inc.
Photochemical, photo processing waste	541		Industrial Silver	Silver recovery probe (electrochemical) Kodak "silver sponge"
Laboratory waste chemicals	551		California Waste Exchange	Neutralization of acids & bases

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial * Recyclers	On-Site Treatment/Vendors **
Alkaline solution with metals	121	Install/operate tanks properly, avoid cross-contamination, remove sludge frequently, reduce evaporation with blankets & freeboard	(Metals may be recyclable) World Resources	Neutralization and dewatering, electro- chemical treatment
Alkaline solution without metals	122	Avoid cross-contamination, increase bath life, lower concentration of bath life, segregate waste streams		Neutralization Vendors: WMI-West Filltronics, Inc. Allied Corp.
Aqueous solution with metals	132	Avoid cross-contamination, increase bath life, lower concentration of bath life, segregate waste streams	(Metals may be recyclable) Chem West International Metal Liquid Chem. Corp.	Dewatering, electro- chemical treatment Vendors: Somat WMI-West Star Systems

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial* Recyclers	On-Site Treatment/Vendors**
Off-specification, aged & surplus inorganics	141	Use "just-in-time" ordering, smaller quantities, frequent supply analysis Test to determine usefulness	California Waste Exchange	
Metal sludge	171		Depends on concentration of metals	Dewatering, Electrochemical treatment Vendors: WMI-West Somat Corp. Alan Engineering Chem Link
Solvents Halogenated Oxygenated Hydrocarbon	211 212 213	Use aqueous detergents for cleaning, powder coating in place of solvent-based finishes, seal-less pumps to avoid leakage, automation to reduce human error, change equipment settings to reduce consumption, reduce evaporation with free-board and blankets, conserve energy & water, use plastic bead blasting for paint stripping	OSCO, Romic, Rho-Chem, Van Water & Rogers Baron-Blakeslee	Distillation, incineration filtration Vendors: Resolv-r, Ampro, Interrel

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial * Recyclers	On-Site Treatment/Vendors **
Contaminated soil (from leaks & spills)	611	Install splash guards and dry boards, prevent tank overflow, use bellow sealed valves, install spill basins, seal-less pumps, secondary containment, plant maintenance, employee training		Aeration, biodegradation, on-site recovery, air stripping Vendors: NEPCCO, Aquifer Remediation Systems
Acid solution with metals	111	Increase plating solution bath life, lower concen- tration of plating bath, use in-line recovery, segregate all waste streams	(Metal sludges may be recyclable after dewatering) Chem West International Metal Liquid Chem. Corp.	Neutralization, dewatering Vendors: WMI-West Somat Star Systems

WASTE REDUCTION METHODOLOGIES

Waste Type	Code	Source Reduction Methods	Commercial * Recyclers	On-Site Treatment/Vendors **
Acid solutions without metals	112	Avoid cross-contamination, remove sludge continuously	Allied Chemical Chem West Liquid Chemical Corp.	Neutralization Vendors: Dow Chemical, Atlantes Chemical, Chem Link
Off-specification, aged, or surplus organics	331	Use "just-in-time" ordering, smaller quantities, frequent supply analysis Test to determine usefulness	California Waste Exchange	
Baghouse waste	591	Use dust suppression method, wet instead of dry grinding, schedule baghouse emptying		
Aqueous solution with organic residues	133 134	Segregate waste streams, avoid cross-contamination, recycler reuse rinsewater, use solvent substitutes		Air stripping, distillation Vendors: NEPCO, Excel Tech.

ATTACHMENT 3 (con't)

WASTE REDUCTION METHODOLOGIES FOR MANUFACTURING OPERATIONS

Examples: Electroplating, Lithographic Printing, Metal Parts Cleaning, Metal Surface Treatment, Paint Application, Printed Circuit Boards

Material Handling:	Raw Materials Inventory Maintained
	1. Segregate containers by prior contents 2. Use rinsable/recyclable drums 3. Purchase materials in bulk or in larger containers 4. Purchase materials in preweighed packages, use first-in, first-out procedures
Solvent Cleaners	1. Install/operate cleaning tanks properly 2. Avoid cross-contamination of solvent 3. Avoid water contamination of solvent 4. Remove sludge continuously 5. Monitor solvent composition 6. Consolidate cold cleaning operations 7. Recycle spent solvent 8. Use plastic bead blasting for paint stripping
Alkaline/Acid Cleaners	1. Install/operate cleaning tanks properly 2. Avoid cross-contamination of solvent 3. Remove sludge frequently
Plating/Etching/ Surface Finishing Solutions	1. Increase plating solution bath life 2. Use lower concentration plating bath 3. Use trivalent Cr in place of hexavalent Cr

4. Use non-cyanide plating solutions
5. Use in-line recovery techniques
6. Regenerate spent bath solutions
7. Segregate all waste streams
8. Inspect all parts for proper cleanliness

Rinse Water

1. Install/operate all rinse tanks properly
2. Use multiple rinse tanks
3. Install drain boards and drip tanks
4. Use fog nozzles and spray units
5. Agitate rinse bath
6. Use deionized water for rinsing
7. Recycle and reuse rinse water
8. Segregate all waste streams
9. Reclaim metal from rinse water

Paint Application

1. Use equipment with low overspray
2. Inspect all parts before painting

Leaks and spills

1. Install splash guards and drip boards
2. Prevent tank overflow
3. Conserve water

ATTACHMENT 3 (con't)

WASTE REDUCTION METHODOLOGIES: COMMODITIES PRODUCED IN BATCHES

Examples: Dyes, Inorganic Pigments, Paint, Agricultural
Chemicals Formulation, Phenolic Resins, Wood Preserving.

- | | |
|--------------------------|---|
| Material Handling: | 1. Segregate containers by prior contents |
| | 2. Use rinseable/recyclable drums |
| | 3. Purchase materials in bulk or in larger containers |
| | 4. Purchase materials in preweighed packages |
| | 5. Use pipeline for intermediate transfer |
| Reaction/Processing Step | 1. Optimize the reaction variables/reactor design |
| | 2. Optimize the reactant addition method |
| | 3. Eliminate the use of toxic catalysts |
| Filtration and Washing | 1. Employ efficient washing/rinsing methods |
| | 2. Eliminate the use of filter aids |
| | 3. Use countercurrent washing |
| | 4. Recycle spent washwater |
| | 5. Maximize sludge dewatering |
| Baghouse Fines | 1. Increase use of dust suppression methods |
| | 2. Use wet instead of dry grinding |
| | 3. Schedule baghouse emptying |
| Off-Spec Product | 1. Tighter control of reaction temperatures |
| | 2. Alter production schedule |

3. Use mechanical wipers on mix tanks
4. Clean mix tanks immediately after use
5. Use a countercurrent rinse sequence
6. Recycle spent rinse water
7. Increase spent rinse settling time
8. Re-examine need for chemical cleaning
9. Dewater spent rinse sludge

Leaks and Spills

1. Use bellow-sealed valves
2. Install spill basins
3. Use canned (seal less) pumps
4. Maximize use of welded vs. flanged pipe joints

ATTACHMENT 4

Training Elements

1. Factors affecting hazardous waste generation and reduction:

- a. technical
- b. non-technical
- c. barriers and incentives (direct and indirect)
- d. legal requirements and other regulatory issues (NPDES, Prop. 65, pre-treatment, etc.)

*Suggested Reading: Reducing Hazardous Waste Generation

National Academy Press

2. Phases of waste reduction programs:

- a. initial
- b. development
- c. mature

*Suggested Reading: Reducing Hazardous Waste Generation

National Academy Press

3. Categories of waste reduction methodologies (in order of preference):

- a. source reduction, abatement
- b. recycling, reuse
- c. treatment

*Suggested Reading: Alternative Technology for Recycling and Treatment of Hazardous Waste

Third Biennial Report, DOHS

4. Source Reduction Activities (advantages and disadvantages of each):

- a. housekeeping
- b. substitution
- c. water conservation
- d. source separation
- e. process modification

Suggested Reading: Technologies and Management Strategies for Hazardous Waste Control
OTA

ATTACHMENT 4 (con't)

5. Recycling, reuse, recovery:

- a. on and off-site methods
- b. California Waste Exchange resources

6. Treatment Technologies:

- a. incineration
- b. filtration
- c. neutralization
- d. precipitation
- e. absorption
- f. evaporation and dewatering
- g. distillation
- h. separation
- i. biological

*Suggested Reading: Technologies and Management Strategies for Hazardous Waste Control
OTA

7. Treatment methods for specified wastes:

- a. corrosive liquids with and without metals
- b. solvents
- c. organic and aqueous solutions
- d. incinerable wastes (BTU requirements)
- e. oils
- f. sludges
- g. plating wastes with cyanides
- h. PCB's
- i. other

*Suggested Reading: Third Biennial Report,
DOHS

8. Emerging Technologies and Applications:

- a. molton salt combustion
- b. fluidized bed incineration
- c. UV/ozone destruction
- d. catalized wet oxidation
- e. dehalogenation with UV light and hydrogen
- f. electron treatment
- g. TTU

*Suggested Reading: Emerging Technologies for Treatment of Hazardous Waste
Edwards, etc.

*See publications for more informational resources (Attachment 10).

ATTACHMENT 5

Example Model Ordinance

AN ORDINANCE OF THE _____ COUNTY BOARD OF
SUPERVISORS ADDING PROVISIONS OF THE _____
COUNTY ORDINANCE CODE PERTAINING TO HAZARDOUS
WASTE AND SUBSTANCES

The Board of Supervisors of the County of _____ does ordain as follows:

CHAPTER 5 - HAZARDOUS WASTE AND SUBSTANCES

1. Article 1 of Chapter 5 of Division 4 of the _____
County Ordinance Code is hereby to read as follows:

ARTICLE 1 - HAZARDOUS WASTE PRODUCERS AND
TRANSPORT FACILITY OPERATORS

Sec. _____ - PURPOSE AND AUTHORITY - The purpose of this Article is to establish a system for licensing business activities which produce hazardous waste, to establish a system of licensing the operation of transport facilities for such waste, and to provide for the collection of fees necessary to pay the county's expenses of issuing such licenses and of enforcing minimum standards and regulations respecting such wastes adopted by the State Department of Health Services pursuant to section 25150 of the Health and Safety Code. The authority of this Article includes the provisions of section 510, section 1155.6, and Chapter 6.5 (commencing with section 25100) of Division 20 of the Health and Safety Code and the provisions of Chapter 30 (commencing with section 66100) of Division 4 of Title 22 of the California Administrative Code.

Sec. _____ - DEFINITIONS - For the purpose of this Article, unless the context otherwise requires:

- (a) "Business activity" means any activity conducted by any person in furtherance of such person's business (regardless of whether such business is for profit) or employment at any location other than a natural person's residence.
- (b) "Hazardous waste" means a waste that consists of material listed in either the List of Chemical Names or the List of Common Names appearing in section 66680 of Title 2 of the California Administrative Code, or a waste that is hazardous according to the criteria set forth in Article 11 (commencing with section 66693) of Chapter 30 of Division 4 of Title 22 of the California Administrative Code.

- (c) "Hazardous waste transport facility" means any location at which any container (including any vacuum tank, cargo tank or other container which is attached to or an integral part of a truck, trailer or semi-trailer) for which a certificate of compliance has been issued or is required pursuant to Article 6.5 (commencing with section 25167.1) of Chapter 6.5 of Division 20 of the Health and Safety Code is stored, cleaned, repaired or otherwise maintained.
- (d) "Location" means a room, enclosure, building, lot, or contiguous group of lots.
- (e) "Manager" means the Manager of the Environmental Division of the Ventura County Resource Management Agency and his or her duly appointed representatives.
- (f) "Minimum standards and regulations" means the minimum standards and regulations respecting hazardous and extremely hazardous wastes adopted by the State Department of Health Services pursuant to section 25150 of the Health and Safety Code.
- (g) "Person" has the meaning assigned to that term by section 25118 of the Health and Safety Code.
- (h) "Waste" has the meaning assigned to that term by section 25122 of the Health and Safety Code.

Section 1 - No person shall engage in the construction of substantial remodeling of a hazardous waste production facility without having a current permit to construct issued by the manager, Environmental Health Department.

Section 2 - Application for and issuance of Permit to Construct - An application for a Permit to Construct must be submitted to the manager in such form as the manager may prescribe, together with two sets of plans for the new construction or remodeling and payment of the Permit to Construct fees established pursuant to Section _____. Within twenty working days the manager shall approve or reject the application. The application shall be approved and the permit issued only if it appears to the manager, upon review of the application, that all applicable State and County Environmental Health requirements will be met. The application must include a proposed program to reduce the volume and toxicity of waste generated to an extent which is economically practicable and which minimizes the present and future threat to human health and the environment.

Section 3 - Term of Permit to Construct - A Permit to Construct shall be valid for a period commencing on the date of issuance and ending either one year thereafter or upon completion of the construction or remodeling for which it was issued, whichever period is shorter. Upon written request the manager may, for good cause shown, extend the one-year term for an additional period not to exceed one year or such shorter period as may be required to complete the construction or remodeling.

Section 4 - No person shall engage in any business activity which produces a hazardous waste unless such activity is either:

- (a) One for which a hazardous waste facility permit from the State Department of Health Services is required by Section 66490 of Title 22 of the California Administrative Code; or
- (b) One for which a current Hazardous Waste Producer's License has been issued by the manager pursuant to this Article. Beginning June 1, 1987, the manager may require that each producer applying for a license provide documented evidence of a program to reduce the volume and toxicity of hazardous waste which will be produced.

Sec. ____ - LICENSE REQUIRED FOR TRANSPORT FACILITY OPERATOR - No person shall operate a hazardous waste transport facility unless such facility is one for which a current Hazardous Waste Transport Facility Operator's License has been issued by the manager pursuant to this Article.

Sec. ____ - APPLICATION FOR AND ISSUANCE OF LICENSE - An application for a Hazardous Waste Producer's License or a Hazardous Waste Transport Facility Operator's License must be submitted to the manager in the form and manner prescribed by the manager. The manager may require that the application include a demonstration, to the satisfaction of the manager, that the activity or facility to which the application pertains will be conducted or operated in accordance with the applicable minimum standards and regulations. The manager shall issue the license upon receipt of a complete application and payment of the applicable fee adopted pursuant to section 4509.

Sec. ____ - TERM AND SCOPE OF LICENSE - Subject to the provisions of section 4508, a Hazardous Waste Producer's License and a Hazardous Waste Transport Facility Operator's License shall be valid for a period of one year from the date of issuance; provided, however, that if one such license has already been issued and is still current, the second license to be issued shall be valid only for the

period of time remaining on the first license. The license document shall identify the specific activity or facility licensed, the specific location or locations at which such activity or facility is to be conducted or operated, and the person or persons to whom the license is issued. The license shall be valid only for the identified activities or facilities conducted or operated at the identified locations by the identified persons.

Sec. ____ - DEFICIENCIES - The manager shall notify the person to whom a Hazardous Waste Producer's License or a Hazardous Waste Transport Facility Operator's License has been issued of any suspected failure to conduct the activity or operate the facility to which the license pertains in accordance with applicable minimum standards and regulations. Such notices shall briefly describe the suspected failure, shall specify a time and place of a hearing at which such person will be afforded an opportunity to present evidence showing there has been no such failure, and shall state that failure to appear and present such evidence may result in revocation of the license.

Sec. ____ - SUSPENSION AND REVOCATION OF LICENSE - A license with respect to which notice has been given pursuant to section 4507 is subject to suspension or revocation as follows:

- (a) The manager shall conduct the hearing specified in the notice. The hearing shall be informal and shall not be governed by rules of evidence applicable to courts of law. The person to whom the license was issued shall have the right to present relevant evidence at the hearing. The manager may, but need not, permit other persons to present relevant evidence. The person to whom the license was issued shall have the burden of proving, by a preponderance of the evidence, that the suspected failure identified in the notice has not in fact occurred. At the conclusion of the hearing, or within a reasonable time thereafter, the manager shall determine whether the suspected failure identified in the notice has occurred. The determination of the manager shall be final and conclusive. Such determination shall be in writing and contain a brief statement of the findings of fact upon which the determination is based. If the determination is that the suspected failure identified in the notice has occurred, the manager shall revoke the license; provided, however, that the manager shall have discretion not to revoke the license if the manager determines that the failure was not willful, is not ongoing, and is not likely to recur.

- 5-5

MODEL

RESOLUTION OF THE BOARD OF SUPERVISORS OF
COUNTY ESTABLISHING FEES FOR
HAZARDOUS WASTE PRODUCER'S LICENSES AND
HAZARDOUS WASTE TRANSPORT FACILITY LICENSES

WHEREAS, _____ County Ordinance Code section _____ provides that the fee for issuance of a Hazardous Waste Producer's License and a Hazardous Waste Transport Facility Operator's License shall be prescribed by resolution of this Board.

NOW, THEREFORE, BE IT RESOLVED, DETERMINED AND ORDERED AS FOLLOWS:

1. The annual fee for a Hazardous Waste Producer's License and the annual fee for a Hazardous Waste Transport Facility Operator's License shall be based upon the number of employees employed by the person to whom the license is issued, at the location for which the license is issued, as follows:

<u>NUMBER OF EMPLOYEES</u>	<u>ANNUAL FEE</u>
1 - 7	\$100.00
8 - 19	150.00
20 - 49	200.00
50 - 99	250.00
100 or more	300.00

2. Permit to Construct Fees

The fee for a Permit to Construct shall be based upon the square footage of areas being constructed or remodeled as follows:

<u>SQUARE FEET</u>	<u>ANNUAL FEE</u>
less than 10	\$ 73
11 - 100	140
101 - 500	171
501 - 1000	207
1001 - 2000	244
2001 - 3000	274
3001 - 4000	337
4001 - 5000	410
5000 or more	506

3. The annual fee specified in Section 1 of the Resolution shall be increased by 10% if the application is submitted at least 30 calendar days but less than 60 calendar days after the activity or operation to which the application pertains has commenced and shall be increased by 60% if the application is submitted 60 or more calendar days after such activity or operation has commenced.
4. The annual fee specified in Section 1 of this Resolution, plus any increase pursuant to Section 3 of this Resolution, shall be reduced by 75% if, at the time the fee is paid, the person to whom the Hazardous Waste Producer's License is issued certifies on a form satisfactory to the Environmental Health Division that, throughout the entire term of the license, such person will, at each location for which the license is issued, comply with all of the following requirements:
 - (a) Maintain a used oil storage tank or tanks having a capacity of at least 100 gallons;
 - (b) Accept up to four gallons of used oil per day per person from any and all persons without charge, except when:
 - (1) the used oil storage tanks are filled to capacity, or
 - (2) the operator of the used oil storage tanks determines that his or her own deposits of used oil require the use of the remaining used oil storage capacity before the storage tanks are emptied; and
 - (c) Conspicuously display a sign, approved by the Manager of the Environmental Health Division advertising the foregoing services.

Failure to comply with the foregoing requirements at any time throughout the term of the license shall render the person to whom the license was issued immediately liable for payment of the amount by which the fee was reduced.

5. If either a Hazardous Waste Producer's License or a Hazardous Waste Transport Operator's License is issued for a location for which the other license has already been issued and is still current, the fee for the second license to be issued shall be waived.

On motion by Supervisor _____, seconded by Supervisor _____, the foregoing resolution was passed and adopted on _____, 19__.

CHAIR, BOARD OF SUPERVISORS

ATTACHMENT 6

Model Resolution On Waste Source Reduction
For Adoption At The Local Government Level

In the matter of establishing
Waste/Source Reduction as a priority
in the use and management of
hazardous materials in the
City/County of _____.

WHEREAS the presence of hazardous substances and hazardous
wastes in the City/County of _____ creates a potential
threat to public health and safety; and

WHEREAS there are cost-effective practices and technologies now
readily available by which to significantly reduce the amount and toxicity
of hazardous materials initially used as well as imposed on society's
waste management capabilities; and

WHEREAS waste/source reduction benefits chemical users by
reducing waste disposal fees and long term liability, as well as the costs
of chemical feedstock materials; and

WHEREAS there is a trend in state and federal law away from
disposing of hazardous wastes in landfills, creating a serious need for
alternatives; and

WHEREAS with the passage of AB 2948, all cities and counties
will be authorized to adopt plans for the management and ultimate disposal
of all hazardous wastes generated within their boundaries;

NOW THEREFORE BE IT RESOLVED that it is the policy of the
City/County of _____ to encourage and promote practices
and technologies that will, in order of priority:

- First, reduce the use of hazardous substances and
the generation of hazardous wastes at their source.
- Second, recover and recycle the remaining waste for
reuse.
- Third, treat those wastes not amenable to source
reduction or recycling so that the environment and
community health are not harmed by their ultimate
release or disposal.

BE IT FURTHER RESOLVED that a copy of this resolution be
forwarded to the appropriate entity in charge of the implementation of AB
2948 for the City/County of _____.

THIS RESOLUTION is part of a document entitled "Waste/Source
Reduction: Part I - Setting Official Policy." The document is the
first in a five-part series produced for local elected officials by
the Local Government Commission. For more information contact:

Local Government Commission
909 - 12th Street, Suite 203
Sacramento, California 95814
(916) 448-1198

ATTACHMENT 7
RESOURCE MANAGEMENT AGENCY
county of ventura

Environmental Health Department
Donald W. Koepf
Director

EXAMPLE INDUSTRY PARTICIPATION REQUEST

September 18, 1986

TO:

RE: PARTICIPATION IN COUNTY HAZARDOUS WASTE VOLUME REDUCTION PROGRAM

The Environmental Health Department, in conjunction with the State Department of Health Services, Toxics Substance Control Division, Alternative Technology Section, is undertaking a hazardous waste volume reduction program for industries in Ventura County. The purpose of the program is to assist hazardous waste generators in the development and implementation of Volume Reduction Plans. There is no cost and confidentiality will be maintained. We would like you to participate in our program by assigning a company representative to work with our staff in the development and implementation of a hazardous waste minimization program for your facility in Ventura County.

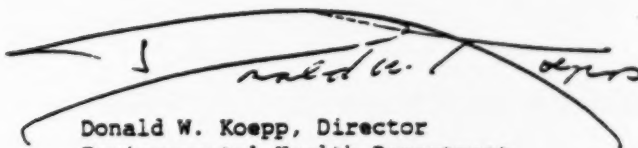
The 1984 amendments to the Resource Conservation and Recovery Act (Sections 3002b and 3005h) require that, as of September 1, 1985, generators have a program in place to reduce the volume and toxicity of wastes produced and to certify on each manifest that this program is being implemented. A typical volume reduction program will include a waste audit at your facility, setting and prioritizing waste minimization goals, and implementing a program to reduce the amount of hazardous waste generated. Ventura County staff will make on-site visits to help you identify alternatives to costly off-site disposal. By visiting each company, our staff can listen, observe and respond to your individual needs.

Waste minimization should not be viewed as a new technology but as a business practice to be incorporated in business systems just as productivity and goal setting mechanisms are. As the best of all waste management practices, waste reduction has been endorsed by industry trade groups, Congress, EPA, the State, and environmental groups.

Many forward thinking companies are already receiving benefits from reducing waste generation. These include dollar savings as well as eliminating transportation and land disposal liabilities. As more companies begin to implement such activities, we will start achieving results for the community's economic and environmental benefit.

Please notify us by October 15, 1986 of the company representative who will be assigned to be a part of this progressive and innovative program. At that time, we will schedule an appointment with your representative to develop an economically feasible and environmentally sound waste minimization program. Confidentiality will be maintained unless specifically authorized. Please contact Deborah Hanlon at (805) 654-2441 if you need more information or have any questions on this subject. Your cooperation is necessary to ensure the success of your waste reduction program.

Sincerely,

A handwritten signature in dark ink, appearing to read "Donald W. Koepp", is written over a horizontal line. The signature is fluid and cursive.

Donald W. Koepp, Director
Environmental Health Department

DWK/kp

PLEASE COMPLETE AND RETURN THIS FORM BY OCTOBER 15, 1986 TO:

**VENTURA COUNTY ENVIRONMENTAL HEALTH DEPARTMENT
HAZARDOUS WASTE MINIMIZATION PROGRAM
800 S. VICTORIA AVE.
VENTURA, CA. 93001**

We would like to participate in the Ventura County Hazardous Waste Minimization Program. The following representative will work with your department to develop and implement an appropriate plan for our company:

NAME: _____

ADDRESS: _____

CITY, STATE: _____

PHONE: _____

COMPANY REPRESENTATIVE: _____

PHONE: _____

COMMENTS:

ATTACHMENT 8

C. Recognition Letter (Example)

Date

Company Name

On behalf of the _____ Board of Supervisors, I want to thank you for your support of the Hazardous Waste Reduction Program. The assistance you have provided has been a valuable contribution to the success of this program. We especially appreciate the contribution that _____ has made to the program through his/her participation.

As you are certainly aware, hazardous waste - its effects upon our health and upon the environment - is an issue of primary concern to us all. Effective long-term solutions to this _____ problem are of critical interest to both industry and government. Your efforts have helped us to achieve a remarkable reduction in hazardous wastes in _____ County.

This is an excellent example of the opportunities for progressive, cooperative action between industry and government. Once again, we thank you.

Sincerely,

Chairman, Board of Supervisors

*The Board of Supervisors
COUNTY OF VENTURA*



Recognition Award

presented to:

*in appreciation for
participation in Ventura County's
Hazardous Waste Reduction Program
May, 1987*

*Maggie Erickson, Chairperson,
Supervisor, District #3*

*Madge Schaefer
Supervisor, District #2*

*Susan Lacey
Supervisor, District #1*

*James Dougherty
Supervisor, District #4*

*John Flynn
Supervisor, District #5*

ATTACHMENT 9

(Example)

HAZARDOUS WASTE MINIMIZATION WORKSHOP

Program Agenda

1. Waste Minimization/Resource Recovery
2. The Role of Liability and Regulation in Encouraging Waste Minimization
3. The Economics of Waste Management Decisions
4. Elements of a Waste Reduction Plan
5. Waste Minimization: Planning, Auditing and Implementation

Case Studies

6. Waste Reduction in the Organic Chemical Industry
7. Hazardous Waste Minimization Technology Transfer
8. Waste Minimization Efforts in the Aerospace Industry
9. Strategic Planning Through Optimal Chemical Control Management
10. The Role of Waste Exchanges in Waste Minimization and Reclamation Efforts

ATTACHMENT 9 (con't)

(Example)

HAZARDOUS WASTE TREATMENT TECHNOLOGIES

Program Agenda

- I. Regulations for On and Off-site Treatment and Pre-treatment
- II. Contaminants and their Impact on POTW's
- III. Activated Carbon Treatment/Air Stripping
- IV. Biological Treatment
- V. Equalization/pH Control
- VI. Sedimentation
- VII. Filtration and Removal; Polishing Systems for Clarifier Overflows
- VIII. Conventional Treatment of Metal Finishing Wastes
- IX. Solution Recovery
- X. Oil Removal
- XI. Industrial Water Conservation and Reuse Practices
- XII. Sludge Dewatering - Metal Finishing Wastewater Treatment
- XIII. Emerging Technologies

ATTACHMENT 10

INFORMATIONAL RESOURCES AND REFERENCES

Hazardous Waste Reduction Publications

California Department of Health Services, Toxic Substances Control Division. Hazardous Waste Disposal Options for California Industry. DOHS, Sacramento, CA. 1986.

California Department of Health Services, Toxic Substances Control Division. Waste Audit Studies. DOHS, Sacramento, CA 1987.

California Institute of Public Affairs. Auditing For Waste Minimization. 1986.

California Waste Exchange, Newsletter/Catalog. DOHS, Alternative Technology Section, Sacramento, CA.

Campbell, Monica E. and William, Glenn. Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling. Pollution Probe Foundation. Toronto, Ontario, Canada. 1982.

Committee on Institutional Considerations in Reducing Generation of Industrial Hazardous Wastes. Reducing Hazardous Waste Generation. National Academy Press, Washington D.C. 1985.

Department of Health Services-Toxic Substances Control Division-Alternative Technology & Policy Department Section. Alternative Technology for Recycling and Treatment of Hazardous Wastes, Biennial Reports. DOHS, Sacramento, CA. 1984 and 1986.

Edwards, B.H., Paullin, J.N., Coghlan-Jordan, K. Emerging Technologies for the Control of Hazardous Wastes. Pollution Technology Review No. 99. Noyes Data Corporation, Park Ridge, NJ. 1983.

Environmental Defense Fund. Approaches to Source Reduction. Berkley, CA. 1986.

"Hazardous & Solid Waste Minimization & Recycling Report". Government Institutes, Inc., Rockville, MD. 1987 (monthly).

ICF Consulting Associates, Inc. Economic Incentives for the Reduction of Hazardous Wastes. ICF Consulting Associates, Los Angeles, CA. 1985.

ICF Consulting Associates, Inc. Economic Incentives for the Reduction of Hazardous Wastes, "Appendices to Final Report". ICF Consulting Associates, Los Angeles, CA. 1985.

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ICF Consulting Associates, Inc. Guide To Solvent Waste Reduction Alternatives. ICF Consulting Associates, Los Angeles, CA. 1986.

ICF Consulting Associates, Inc. Solvent Waste Reduction Alternatives Symposia. ICF Consulting Associates, Los Angeles, CA. 1986.

Industrial Material Exchange Service. Illinois Environmental Protection Agency, Illinois State Chamber of Commerce, Springfield, IL. 1987.

Local Government Commission. Waste Source Reduction: Part I Setting Official Policy. Sacramento, CA. 1986.

Noll, Schmidt, Haas, Kodukula. Recovery, Recycle and Reuse of Industrial Waste. Lewis Publishers, Inc., Chelsea, Michigan. 1985.

Sarokin, David J., Muir, Warren R. PhD., Miller, Catherine G. PhD., Sperber, Sebastian R. Cutting Chemical Wastes. Inform, Inc., New York, NY. 1985.

Tavlarides, Lawrence L. PhD. Process Modifications for Industrial Pollution Source Reduction. Lewis Publishers, Inc., Chelsea, Michigan. 1985.

U.S. Congressional Budget Office. Hazardous Waste Management: Recent Changes and Policy Alternatives. Washington D.C. May 1985.

U.S. Congress, Office of Technology Assessment. Serious Reduction of Hazardous Waste. U.S. Government Printing Office, Washington D.C. 1986.

U.S. Congress, Office of Technology Assessment. Technologies and Management Strategies for Hazardous Waste Control. U.S. Government Printing Office, Washington D.C.

U.S. Environmental Protection Agency. Environmental Regulations and Technology, "The Electroplating Industry". EPA 625/10-80-001. 1980.

U.S. Environmental Protection Agency. Management of Metal-Finishing Sludge. U.S. Environmental Protection Agency, Cincinnati, Ohio. 1977.